



FAA-E-2019b
March 20, 1970

SUPERSEDING
FAA-E-2019a, 1/19/68

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION SPECIFICATION

ANTENNA, VHF, CIRCULARLY POLARIZED

1. SCOPE

1.1 Scope.- This specification covers a circularly polarized VHF transmitting antenna designed for attachment to a supporting pipe and to match a 50 ohm RG-8A/U transmission line.

1.2 Frequency range.- The antenna is required to operate within the frequency range of 118 to 144 MHz.

2. APPLICABLE DOCUMENTS

2.1 FAA specifications.- The following FAA specifications, of the issues specified in the invitation for bid or request for proposals, form a part of this specification (see FAA-G-2100/1 Paragraph 1-2 for source of copies).

FAA-D-1272 Instruction Booklets, Electronic Equipment

FAA-G-2100/1 Electronic Equipment, General Requirements
Part 1, General Requirements for all Equipments

3. REQUIREMENTS

3.1 Equipment to be furnished by contractor.- Each antenna furnished by the contractor shall be complete in accordance with all specification requirements. The 20-foot supporting pipe and the coaxial input cable are not required. Polarization of antennas (3.5), and quantity of instruction booklets in accordance with FAA-D-1272, shall be furnished as required in the contract schedule.

3.2 Definitions

3.2.1 Right-handed elliptically polarized antenna.- An antenna that radiates an elliptically polarized wave in which the rotation of the direction of displacement is clockwise for an observer looking in the direction the wave is traveling. (Re: Standards on Radio Wave Propagation, 1942, Institute of Radio Engineers, New York, New York.)

3.2.2 Left-handed elliptically polarized antenna.- An antenna that radiates an elliptically polarized wave in which the rotation of the direction of displacement is counterclockwise to (3.2.1) for an observer looking in the direction the wave is traveling.

3.3 General.- The antenna shall essentially comprise four in-phase dipoles arranged as shown in Figure 1 (right-hand polarization is illustrated).

3.4 Frequency range.- Except where otherwise specified, all specification requirements shall be met through the frequency range of 118 MHz to 144 MHz.

3.5 Type of polarization.- The radiation from the antenna shall be either left- or right-handed elliptically polarized, approaching circular polarization in the horizontal direction. The direction of rotation will be furnished as called for in the contract schedule.

3.6 Antenna impedance.- The impedance of the antenna over the specified frequency range shall be designed to operate with 50 ohm coaxial transmission lines.

3.7 Standing wave ratio.- The standing wave ratio of the antenna shall not exceed the limits specified below.

<u>Frequency Range</u>	<u>SWR</u>
118 to 127 MHz	Not greater than 1.5
127 to 136 MHz	Not greater than 2.0
136 to 144 MHz	Not greater than 2.5

3.8 Power rating.- The antenna shall operate continuously, without failure, with an average RF input power of 200 watts.

3.9 Gain.- The average gain in the horizontal and the vertical plane shall be down not more than 4 dB compared to the results obtained from a similarly polarized standard dipole antenna measurement.

3.10 Horizontal field pattern.- The free space horizontal field pattern (from vertical to horizontal polarization) at each vertical angle of elevation from 0 up to 20 degrees shall not depart from a true circle by more than +1.5 dB.

3.11 Vertical field pattern.- The maximum free space field intensity for the horizontal polarization shall occur at an angle not greater than 20 degrees above the horizontal plane and the maximum free space field intensity for all the vertical polarization shall occur at an angle not greater than 50 degrees above the horizontal.

3.12 Polarization ratio.- The average field intensity of the vertically polarized radiation at each vertical angle of elevation from 0 to 20 degrees above the horizontal plane shall not differ by more than +3 dB from the average field intensity of the horizontally polarized radiation at the same vertical angle.

3.13 Construction

3.13.1 Input connector.- The RF connection shall be made by means of a type "N" connector equipped with a captivated pin. Both connector plug and receptacle shall be furnished. The receptacle shall be mounted in a manner that it can be easily removed for replacement.

3.13.2 Hub and elements.- Each hub section shall be of one piece, cast aluminum. The elements shall be permanently attached to the hubs.

3.13.3 Lower hub and bolt holes.- The lower hub bolt holes shall be drilled to a depth of not more than 1/8 inch from the bottom and shall be tapped.

3.13.4 Connecting bolts.- Nylon or equivalent bolts shall be used to secure the upper hub to the lower hub and shall have a nominal diameter of 1/2 inch and threaded with a No. 13 thread. Each of these four bolts shall have minimum tensile and shear strengths to meet all of the specification requirements.

3.13.5 Washer and O-ring.- An aluminum washer and a neoprene O-ring gasket shall be used under each bolt head. The upper hub holes shall be sufficiently countersunk so that the bolt head and aluminum washer will compress the O-ring gasket around the bolt without damage to the O-ring.

3.13.6 Spacing insulator gaskets.- A neoprene gasket shall be used above and below the hub spacing insulator. Flat gaskets shall be the same diameter as the hubs and insulator after the antenna is assembled. Neoprene O-ring gaskets that are seated in half-round grooves may be used in lieu of flat gaskets.

3.14 Protection against atmospheric electricity.- Each antenna shall be provided with a spark gap with one terminal at ground potential for protection against atmospheric electricity. The gap length shall be 1/16 inch to 1/8 inch. The design shall provide for convenient removal, replacement and setting of the gap electrode.

3.15 Mounting.- The antenna assembly shall be designed for mounting on a standard 2-1/2 inch (I. P. S.), 20-foot free-standing supporting pipe. The contractor shall state, in the installation instructions, the size of pipe required. The fitting shown on Figure 2 shall be provided for mounting the antenna on the supported pipe. Provision shall be made for connecting RG-8A/U coaxial cable to the antenna using the specified connectors (3.13.1). Installation of the cable shall be inside of the supporting pipe. The location of the connector inside the hub fitting (Figure 2) shall be such as to afford convenient connection and disconnection of the mating connector plug (3.13.1) by hand without the use of any kind of tools.

3.16 Mechanical

3.16.1 Ambient conditions.- The ambient conditions shall be those of Environment III of FAA-G-2100/1.

3.17 Waterproofing.- All cavities or hollows present in the completed antenna assembly shall be completely filled with a moisture proofing compound, whether or not such cavities are protected by gaskets.

3.17.1 Leakage.- Immerse the antenna in tap water for 24 hours. Remove and allow to stand under existing room temperature and humidity conditions for not more than one hour. With 500 V, applied across the antenna input connectors, the leakage currents due to moisture shall not exceed 10 micro-amperes.

3.18 Nameplate.- Each antenna furnished shall have a nameplate in accordance with FAA-G-2100/1. The nameplate title shall be ANTENNA, VHF, CIRCULARLY POLARIZED, followed by the letter "L" or "R" indicating direction of rotation.

3.19 Insulating material.- Applications of insulating material shall be such that none of the RF voltage spacing limits given in the following table are exceeded under the conditions specified for the antenna. Surface voltage/spacing limits shall be determined by the shortest net metal-to-metal path over the surface of the insulating material. Dielectric strength voltage/spacing limits shall be determined by the shortest net metal-to-metal path through the material.

SURFACE LIMITS

<u>Gradient</u>	<u>Minimum Path</u>
5000 V max./inch	1/8 inch

DIELECTRIC STRENGTH LIMITS

30,000 V max./inch	1/16 inch
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Unless otherwise specified, all insulating materials shall be Plumb Chemical Company's No. Fibercore 3000 or equal. (Modifies FAA-G-2100/1.)

3.20 Finishes

3.20.1 Antenna finish.- All visible metal parts shall be alkali etched and completely coated with a suitable primer, baked on, followed by a complete coat of light gray enamel, baked on. The contractor shall furnish certification that the primer and finish coat of paint is suitable for outdoor use over a temperature range from -50°C to +60°C and relative humidity of 95 percent.

4. QUALITY ASSURANCE PROVISIONS

4.1 General see 1-4 of FAA-G-2100/1.

4.2 Design qualification tests.- The following design qualification tests shall be performed under normal test conditions:

<u>Test</u>	<u>Paragraph</u>
SWR 118 to 144 MHz	
1 MHz steps	3.7, 4.4
Gain 118, 126, 144 MHz	3.9, 4.6
Horizontal pattern	
118, 126, 144 MHz	3.10, 4.7, 4.7.1
Vertical pattern	
118, 126, 144 MHz	3.11, 4.7, 4.7.2
Voltage test	4.5
Polarization ratio	
118, 126, 144 MHz	3.12, 4.7, 4.7.3
Wind and ice	3.16.1; 1-4.10 of FAA-G-2100/1.
Leakage test (after water immersion)	4.5

4.3 Type test.- The following type test shall be performed under normal test conditions:

<u>Test</u>	<u>Paragraph</u>
SWR 118, 122, 126, 130	
136, 144 MHz to be performed after leakage test	3.7, 4.4
Leakage test (after water immersion)	3.17.1

4.3.1 Production testsTestParagraph

SWR 122 MHz

3.7, 4.4

4.4 SWR.- For type testing, measure the SWR at six frequencies. During the design qualification test the 1 MHz step data shall be recorded over the range of 118 to 144 MHz for the purpose of obtaining a smooth curve of SWR versus frequency. This data shall be included in the form of a graph in the instruction booklets. For production testing, obtain the SWR at one frequency.

4.5 Voltage test.- Apply a 1000 V AC 60 Hz, continuously for ten minutes or more to the antenna input. At the end of test, disassemble the antenna and examine for any indication of damage to insulation material, flash-overs, etc.

4.6 Gain.- Determination of compliance with paragraph 3.9 shall be made by computation based on the measured radiation patterns.

4.7 Radiation.- At the option of the contractor, a vertical dipole, or some similar antenna shall be used as a pick-up antenna for the test meter used to measure the relative field intensities in the test listed below. The pick-up antenna shall be located a minimum to ten wave lengths from the antenna under test. Sufficient readings shall be obtained to permit the drawing of smooth curves for the radiation patterns.

4.7.1 Horizontal field intensity pattern.- Compliance with paragraph 3.10 shall be determined by mounting the antenna under test with its normally vertical axis in the vertical position and rotating the antenna about its vertical axis with the pick-up antenna properly polarized to measure horizontal and/or vertical polarization.

4.7.2 Vertical field intensity pattern.- Compliance with paragraph 3.11 shall be determined by mounting the antenna under test with its normally vertical axis in a horizontal position and rotating the antenna about a vertical axis with the pick-up antenna properly polarized to measure horizontal and/or vertical polarization at zero angle elevation.

4.7.3 Polarization ratio.- Compliance with paragraph 3.12 shall be determined by mounting the antenna under test with its vertical axis in a vertical position. Measurements of the vertical and horizontal polarization shall be performed with the pick-up antenna properly polarized and located at successive angles of elevation.

4.8 Visual inspection.- All antennas shall be inspected visually to determine compliance with mechanical requirements, electrical continuity, and general workmanship.

5. PREPARATION FOR DELIVERY

5.1 General.- See FAA-G-2100/1.

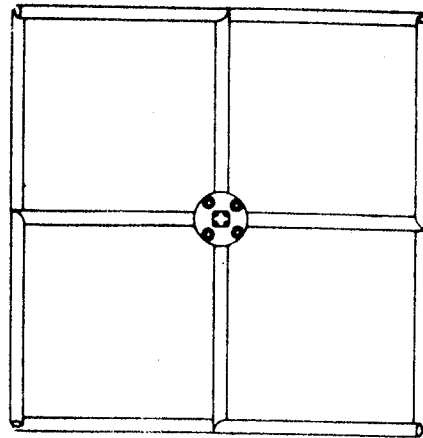
5.2 Packing.- Each complete antenna shall be packed in an individual shipping container.

6. NOTES

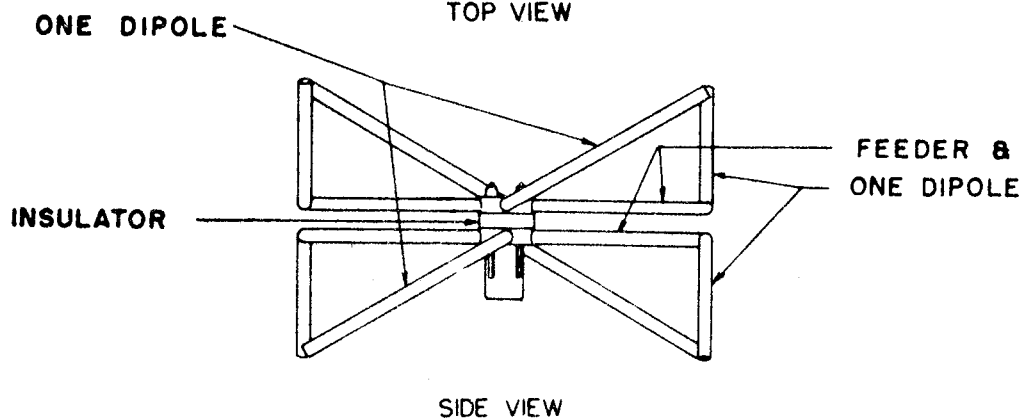
6.1 None.

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For Figures 1 and 2, see pages 8 and 9.



TOP VIEW



SIDE VIEW

(EACH OF THE OTHER 3 SIDES HAS SAME APPEARANCE)

NOTES:

PIPE SUPPORT NOT SHOW.

ANGLES AND DIMENSIONS DEPICTED IN THIS DRAWING ARE NOT TO SCALE.

CONFIGURATION IS NOT MANDATORY.

FIGURE 1

ANTENNA CONFIGURATION

SHAPE ABOVE THIS POINT AS REQUIRED TO MOUNT ANTENNA ON HUB

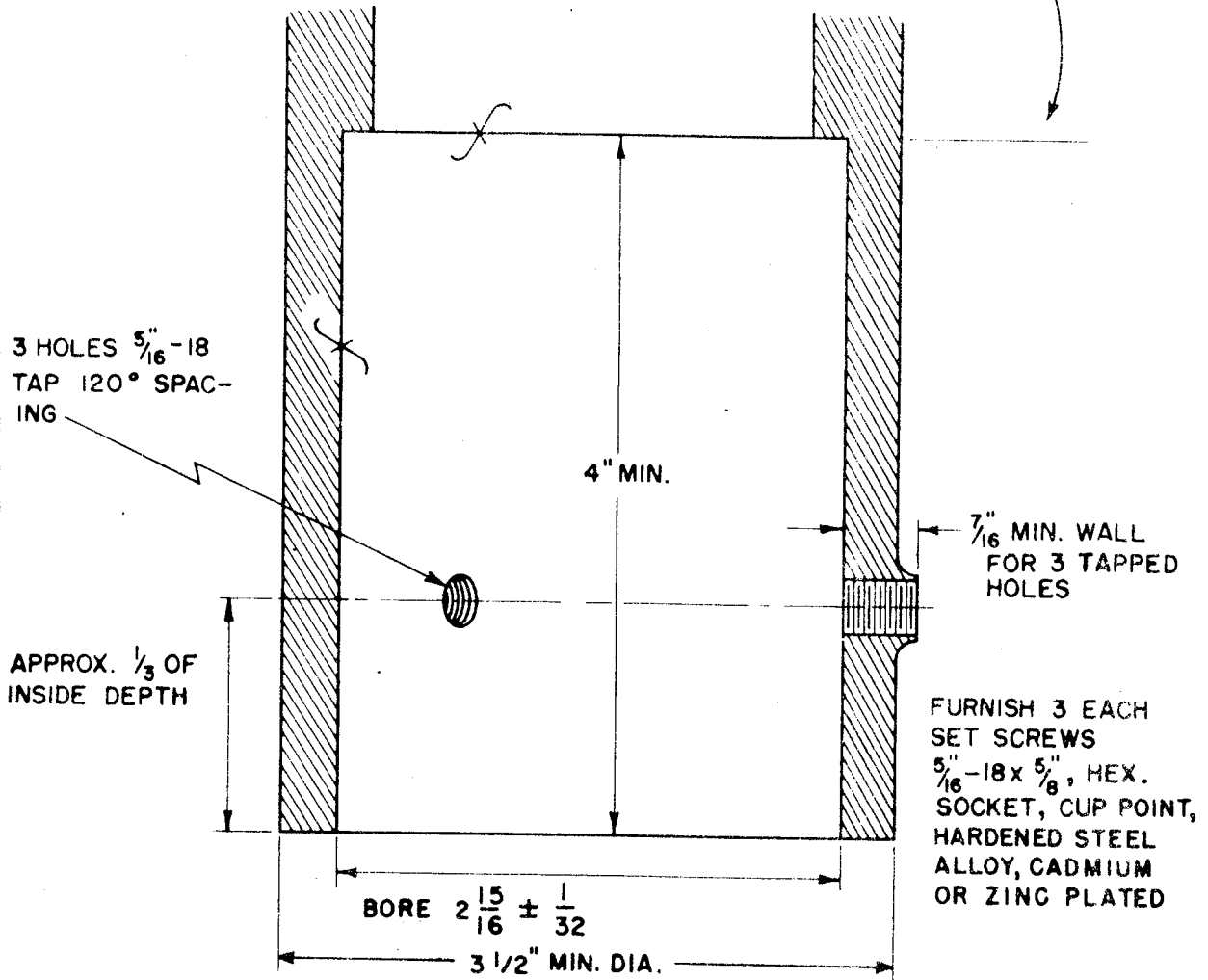


FIGURE 2

ANTENNA-TO-PIPE MOUNTING HUB

